

SIEMENS



PATENT
Attorney Docket No. 2003P07614US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Inventor:	R. Ruka et al.)		
)	Group Art Unit:	1745
Serial No.:	10/663,949)		
)	Examiner:	M. Austin
Filed:	September 16, 2003)		

Title: PLASMA SPRAYED CERAMIC-METAL FUEL ELECTRODE

Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

DECLARATION OF GEORGE R. FOLSER
UNDER 37 C.F.R. § 1.31

1. I, George R. Folser, a citizen of the United States, hereby declare and state as follows:
2. I am a co-inventor of the above-identified patent application.
3. I have been continuously employed by Siemens Westinghouse Power Corporation and its predecessor, Westinghouse Electric Corporation, since July 1970. I am currently a senior engineer within the stationary fuel cells division.
4. Prior to February 28, 2003, I, along with my co-inventors Roswell J. Ruka and Srikanth Gopalan, conceived in the United States an embodiment of the invention

disclosed and claimed in above-identified patent application. We submitted an Invention Disclosure form that included a description of our invention on March 2, 2001 to the Siemens Westinghouse Power Corporation Intellectual Property Department, a copy of which is attached as Exhibit 1.

5. After submitting the Invention Disclosure, we diligently refined our invention and reduced it to final development and practice, as evidenced by the email from our in-house patent attorney John Musone to me dated December 11, 2002 which is attached as Exhibit 2.

6. Soon after refining our invention to final development, we reviewed a patent application for our invention that was prepared by John Musone, as evidenced by the email from John Musone to me dated February 28, 2003 which is attached as Exhibit 3.

7. There were difficulties in making some final edits that we made to the patent application because the US Army reactivated John Musone for military service in the war on terror and a suitable replacement had to be found, as evidenced by the email from Sandra Steunenbergh to me dated June 4, 2003 which is attached as Exhibit 4.

8. After the final edits were made to the patent application, I signed the formal patent documents (declaration and assignment). However, on information and belief, I understand that there were difficulties in obtaining the formal document signatures from Srikanth Gopalan who had recently terminated his employment with Siemens

Westinghouse Power Corporation and began employment as a Professor at Boston University, as evidenced by the email from Sandra Steunenberg to Srikanth Gopalan email dated August 14, 2003 which is attached as Exhibit 5.

9. On information and belief, in accordance with standard corporate practices, the fully revised and signed patent application was diligently filed with the US Patent Office on September 16, 2003.

10. On information and belief, at all times prior to filing, the invention was maintained as Siemens Westinghouse confidential information and not publicly available.

11. On information and belief, as exemplified above, my co-inventors and I, as well as the Siemens Westinghouse Intellectual Property department, exercised due diligence from the conception and reduction to practice (prior to February 28, 2003) to filing the patent application (September 16, 2003).

12. All statements made herein of my own knowledge are true, and all statements made of information and belief are believed true. I acknowledge that willful false statements and the like are punishable by fine or imprisonment, or both, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: 1/26/05

By: 

George R. Folser

FEB 1 2005

INVENTION (INV) DISCLOSURE

Page 1 of 6

Return this completed form
with any necessary attachments, to

SIEMENS CORPORATION
Intellectual Property Department (IPD)
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fax 1-407-281-5048

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THIS SECTION FOR IPD USE ONLY

Division/Dept Code _____
Cost Center Code 2560
Docket No. 2001E04298US
IP Attorney 3560 SOFC B.78

1. Your Div.'s Project # _____ Title of the invention Process for Obtaining Thermal Cyclable Fuel Electrodes by a Plasma Spray Method
2. INVENTOR

At the time the invention was conceived, this inventor was
☒ an employee of a German legal entity (e.g. Siemens AG)
☐ an employee of a non-German entity (e.g. Siemens Automotive Corporation or Siemens Canada Limited)
If you are not sure, contact IPD at +1-407-281-2415

Full Name Roswell J. Ruka
Home Address 51 Churchill Road
Pittsburgh, PA 15235

Citizen of U.S.A.
Soc. Sec. # 389-28-3089

COMPANY/LOCATION INFORMATION

Employer Siemens Westinghouse Power Corporation
Division SFC
Address 1310 Beulah Road
Pittsburgh, Pennsylvania 15235-5098

Work telephone 412-256-1695
Fax 412-256-5504
Email roswell.ruka@swpc.siemens.com

Signature Roswell J. Ruka
Date 3/2/2001

3. CO-INVENTOR (if any)
(use additional forms for more co-inventors)

At the time the invention was conceived, this inventor was
☒ an employee of a German legal entity (e.g. Siemens AG)
☐ an employee of a non-German entity (e.g. Siemens Automotive Corporation or Siemens Canada Limited)
If you are not sure, contact IPD at +1-407-281-2415

Full Name George R. Folser
Home Address 154 Edward St.
Lower Burrell, PA 15068

Citizen of U.S.A.
Soc. Sec. # 204-32-7028

COMPANY/LOCATION INFORMATION

Employer Siemens Westinghouse Power Corporation
Division SFC
Address 1310 Beulah Road
Pittsburgh, Pennsylvania 15235-5098

Work telephone 412-256-5528
Fax 412-256-5504
Email george.folser@swpc.siemens.com

Signature George R. Folser
Date 3-2-01

4. Purpose(s), and likely field(s) of use of this invention Application in SOFC generators
5. Is this invention still secret within Siemens? YES ☒ NO ☐
Do you soon plan to make the invention information available outside of Siemens? YES ☐ NO ☒
Based on your answer to Question #5, explain when and how this invention was/will be made available to someone outside of Siemens (e.g. trade show at location/date, customer presentation at company/location/attendees/date, supplier prototyping by company/date, included in product brochure or advertisement in publication/date, industry technical symposium paper presented place/date, etc)
6. Where is this invention described? List all documents containing aspects of this invention (e.g. engineer notebook date/page, internal status report, test logs, physical prototypes, customer presentation, etc)
This document
7. What date do you recall creating this invention? _____
When do you recall first explaining this invention to a witness who is not also a co-inventor? _____
Who was that witness? _____
Has this invention been prototyped or tested yet? If so, when, where, by who? What were the results?
Presently a cell test is being assembled.
8. I have ☒ have not ☐ attached 2 number of additional sheets to better describe this invention.
9. Was this invention developed under, or quoted for, a customer contract? YES ☐ NO ☒
Was it developed under a government contract? YES ☒ NO ☐
If yes to either, please give contract name and number, and further explain the situation DE-FC26-97FT34139

IF THE ANSWERS TO ANY OF THESE QUESTIONS CHANGE BEFORE THIS INVENTION IS FILED AS A PATENT APPLICATION WITH THE GOVERNMENT, MAKE SURE TO SEND AN UPDATE TO THE IPD.

10. WITNESSED AND UNDERSTOOD BY:

Signature Gianfranco DiGiuseppe
Name GIANFRANCO DIGIUSEPPE
Date 3/2/01

Company Name Siemens Westinghouse
Company Address 1310 Beulah Rd
Pittsburgh, Pa 15235

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Receipt Date Stamp

Division/Dept Code _____

Cost Center Code _____

Docket No. _____

IP Attorney _____

1. Your Div.'s Project # _____ Title of the invention Process for Obtaining Thermal Cyclable Fuel Electrodes by a Plasma Spray Method
2. INVENTOR

At the time the invention was conceived, this inventor was
☐ an employee of a German legal entity (e.g. Siemens AG)
☒ an employee of a non-German entity (e.g. Siemens Automotive Corporation or Siemens Canada Limited)
If you are not sure, contact IPD at +1-407-281-2415

Full Name Srikanth Gopalan
Home Address 312 Penn Lear Ct.
Monroeville, PA 15166

Citizen of U.S.A.
Soc. Sec. # 646-03-7864

COMPANY/LOCATION INFORMATION

Employer Siemens Westinghouse Power Corporation
Division SFC Technology and Innovation
Address 1310 Beulah Road
Pittsburgh, Pennsylvania 15235-5098

Work telephone 412-256-1660
Fax 412-256-5504
Email srikanth.gopalan@swpc.siemens.com

Signature G. Srikanth
Date 3/2/01

3. CO-INVENTOR (if any)
(use additional forms for more co-inventors)

At the time the invention was conceived, this inventor was
☐ an employee of a German legal entity (e.g. Siemens AG)
☐ an employee of a non-German entity (e.g. Siemens Automotive Corporation or Siemens Canada Limited)
If you are not sure, contact IPD at +1-407-281-2415

Full Name _____
Home Address _____

Citizen of _____
Soc. Sec. # _____

COMPANY/LOCATION INFORMATION

Employer _____
Division _____
Address _____

Work telephone _____
Fax _____
Email _____

Signature _____
Date _____

4. Purpose(s), and likely field(s) of use of this invention _____
5. Is this invention still secret within Siemens? YES ☒ NO ☐

Do you soon plan to make the invention information available outside of Siemens? YES ☐ NO ☒
Based on your answer to Question #5, explain when and how this invention was/will be made available to someone outside of Siemens (e.g. trade show at location/date, customer presentation at company/location/attendees/date, supplier prototyping by company/date, included in product brochure or advertisement in publication/date, industry technical symposium paper presented place/date, etc)

6. Where is this invention described? List all documents containing aspects of this invention (e.g. engineer notebook date/page, internal status report, test logs, physical prototypes, customer presentation, etc)
This document

7. What date do you recall creating this invention? _____
When do you recall first explaining this invention to a witness who is not also a co-inventor? _____
Who was that witness? _____
Has this invention been prototyped or tested yet? If so, when, where, by who? What were the results?
Presently a cell test is being assembled.

8. I have ☒ have not ☐ attached 2 number of additional sheets to better describe this invention.

9. Was this invention developed under, or quoted for, a customer contract? YES ☐ NO ☒
Was it developed under a government contract? YES ☐ NO ☐
If yes to either, please give contract name and number, and further explain the situation _____

IF THE ANSWERS TO ANY OF THESE QUESTIONS CHANGE BEFORE THIS INVENTION IS FILED AS A PATENT APPLICATION WITH THE GOVERNMENT, MAKE SURE TO SEND AN UPDATE TO THE IPD.

10. WITNESSED AND UNDERSTOOD BY:

Signature [Signature]
Name GIANFRANCO DI GIUSEPPE
Date 3/2/01

Company Name Siemens Westinghouse
Company Address 1310 Beulah Rd.
Pittsburgh, Pa. 15235

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INSTRUCTION ON HOW TO USE THIS INVENTION (INV) DISCLOSURE

General

- PLEASE TYPE OR PRINT CLEARLY. Answer all questions. Use N/A when not applicable.
- Sign and date each page of the INV Disclosure in ink.
Sign and date all attached additional sheets, diagrams, photographs, etc.,
Please provide all of your given names in full in sections 2 and 3. When there are more than two inventors, use another form and complete and items 1, 2, 3 and 10 on the extra forms.
- Every page of the form and accompanying papers should bear the signature of a witness and the date of his/her signing. The witness should have read the forms and attached papers, and should understand the invention before witnessing. The witness should have a technical background related to the invention, to reduce the chances that someone can later challenge his/her ability to have understood the invention.
- A co-inventor should not be the witness. If you have a choice of several qualified witnesses choose the witness you believe is most likely to still be a Siemens employee available in this country if a question comes up several years from now. That means you should avoid having a co-op student, contract engineer, or a retiring engineer serve as your witness.

Detailed Description

- The description you provide may serve as the basis for a patent application. Therefore, be as complete and as accurate as possible. Attach pages as necessary, using the following checklist as a guide for content.
 - *Abstract*
In one or two sentences describe briefly what your invention does and how it is used,
e.g., "A voltage-controlled oscillator (VCO) has its period controlled by a current provided by a current source. The current is proportional to the reciprocal of a control signal so that the VCO frequency is directly proportional to the control signal."
 - *Background Information*
What is the function of your invention?
What is the problem solved by your invention?
How was the function of your invention performed by the prior work?
What are the disadvantages of the prior work?
What are the advantages of your invention over the prior work?
 - *Details*
Describe in detail the structural and functional operation of your invention. Use drawings and graphs where they would be helpful. Give specific details, not just general information.
Point out what improvements your invention incorporates or the superior performance which is obtained and why it is obtained (if you know why).
Are there alternative methods or different structural embodiments of your invention?
Can the general idea or technique of your invention be extended to other related fields? How?
Which features are believed to be new?
Describe how you best envision your invention being put to use.

Prior Art

Attach a copy (for bibliographic citation) of all publications, patents, etc. that you know about which relate to your invention, and which you think might be important to consider in understanding how your invention differs from prior work.

REMEMBER TO UPDATE THE IPD OF ANY OF THE INFORMATION YOU PROVIDED CHANGES.

☒ Yes, I promise I will update the Siemens Intellectual Property Department (IPD) if any of the information I've provided changes.

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**SUPPLEMENTAL SHEET
FOR INVENTION (INV) DISCLOSURE**

Page 4 of 6

TITLE

Process For Obtaining Thermal Cyclable Fuel Electrodes by a Plasma Spray Method

BACKGROUND

Metal cermet fuel electrodes such as porous nickel/yttria stabilized zirconia (YSZ) are commonly used in Solid Oxide Electrolyte Fuel Cells (SOFC) Solid Oxide Electrolysis Cells (SOECS) and oxygen pumps. Typically, these are applied to a thin film zirconia based electrolyte by a high temperature sintering process or by a method in which a stabilized zirconia layer forms as a "skeleton" around a porous layer of nickel particles on a zirconia type electrolyte and attaches itself firmly to the electrolyte as well. Both of these methods form a strongly adhering nickel/YSZ fuel electrode which can be thermal cycled without detaching and can survive thermal cycling.

A third method of applying such an electrode is by plasma spraying. However, to provide the combined mechanical, electrical and structural requirements for the fuel electrode such temperature cyclability, adequate porosity and high electrical conductivity is more of a problem. Adherence of the cermet layer to the electrolyte produced by the electrochemical vapor deposition (EVD) process, prevents the bond strength needed for the cermet layer.

THE INVENTION

We disclose processes for obtaining cermet electrodes of nickel/stabilized zirconia or copper stabilized zirconia where the zirconia is preferably stabilized by yttria (in solid solution) and is used with a Siemens-Westinghouse type tubular fuel cell although it is not restricted to this SOFC geometry.

For the case of a copper cermet fuel electrode, a porous tube of lanthanum manganite doped with calcium and other components to provide desired chemical stability, electrical conductivity and thermal expansion with surface coating layers of an EVD zirconia type electrolyte and a doped lanthanum chromite interconnection as described in earlier patents is given an additional thin film layer. Typically 5 to 20 μm coating of YSZ, which after sintering at 1300°C or above, provides a surface textures which is porous and rougher than the underlying EVD electrolyte. A plasma spray copper electrode adheres well to this modified surface structure, in contrast to its very poor adherence to an unmodified EVD electrolyte surface. The underlying EVD electrolyte layer is necessary for this application since it is very dense and pore free. This requirement is necessary to prevent copper penetration which will electrically short-circuit the cell.

The surface coat of a stabilized zirconia (e.g. YSZ) over an EVD electrolyte is similarly useful for obtaining and adherent nickel cermet (e.g. Ni/YSZ) fuel electrode on a SOFC. However, since penetration of the electrolyte by nickel is not such a severe problem as it is with copper we can obtain an adherent plasma spray Ni/YSZ electrode on an unmodified plasma spray electrolyte. Plasma spray electrolyte produces a rougher surface texture than an EVD electrolyte film which enhances the adherence of the Ni/YSZ electrode.

Inventor's Signature: *Roswell J. Ruck*

Date: 3/2/2001

Witness' Signature: *G. Srikenth*

Date: 3/2/01

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**SUPPLEMENTAL SHEET
FOR INVENTION (INV) DISCLOSURE**

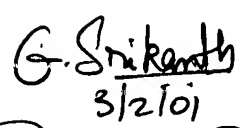
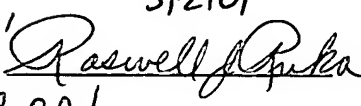
Page 5 of 6


A SOFC with a combined plasma spray electrolyte and nickel/YSZ fuel electrode has been on test for over a year and still shows a good performance. Figure 1 shows the stable operation of this cell, running at about 300mA/cm² for 10,600 hrs. with eight thermal cycles.

CLAIMS

- 1) A process for producing an adherent metal cermet fuel electrode on the electrolyte of an SOFC by a plasma spray process which results in a high conductivity, porous, low polarization electrode capable of being temperature cycled without damage.
- 2) The process (1) where the electrode is a copper + stabilized zirconia, preferably Yttria-stabilized zirconia (YSZ) consisting of a first thin layer made by an electrochemical vapor deposition (EVD) process overlaid by a thin sintered layer of a similar composition.
- 3) The process (1) where the electrode is a nickel + stabilized zirconia cermet and the electrolyte is produced either plasma spraying stabilized zirconia (preferably YSZ) or by combining a first layer of EVD with a second thin layer of sintered stabilized zirconia (preferably YSZ).
- 4) Processes (2) and (3) where the sintered portion of the electrolyte is made from Sub-micron particles of stabilized zirconia (preferably YSZ)
- 5) Processes (2), (3), and (4) where the yttria-stabilized zirconia (YSZ) has a chemical Composition with 8 to 16 mole per cent of the zirconia replaced by yttria (e.g. $Zr_{1-x}Y_xO_{2-x/2}$ where x lies at or between .08 and .16).


Inventor's Signature: George R. Porter
Date: 3/2/2001


3/2/01

Date: 3/2/2001

Witness' Signature: 
Date: 3/2/01

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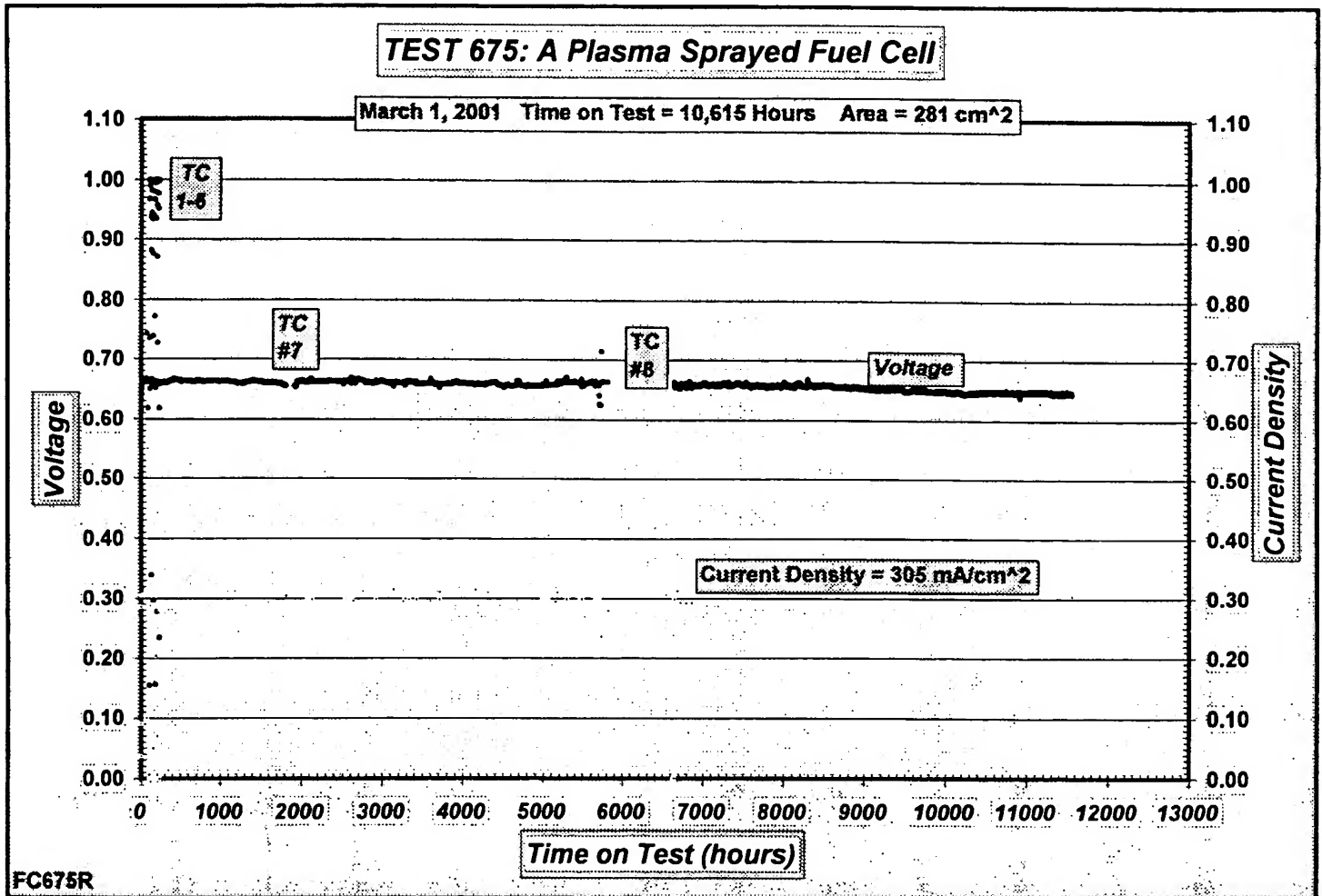


Figure 1

G. Srikanth
3/2/01
Inventor's Signature: *Roswell J. Gupta*
Date: 3/2/2001

Witness' Signature: *[Signature]*
Date: 3/2/01

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Musone John P SWPCLC

From: Musone John
Sent: Wednesday, December 11, 2002 8:55 AM
To: Folser George R
Subject: You APS Fuel Electrode Invention Disclosure

George, what is the status of the work that you were doing to refine the APS Fuel Electrode process (Invention Disclosure No. 2001E04298US) that we were preparing a patent application? You may recall that when we were preparing the patent application for the APS Interlayer (Invention Disclosure No. 2001E04293US, which we filed in September 2002 as 2002P13915), we decided to put the APS Fuel Electrode patent application "on hold" because you were refining the process. I would like to move this patent application along if possible. Thanks. John

John P. Musone, Esq.
Intellectual Property Counsel
Siemens Corporation
4400 Alafaya Trail
Orlando, FL 32826
(407) 736-6449 (ph)
(407) 736-6440 (fax)
john.musone@siemens.com

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Tracking: Recipient
Folser George R

Musone John P SWPCLC

From: Musone John
Sent: Friday, February 28, 2003 11:00 AM
To: Folser George R
Cc: Steunenberg Sandra J
Subject: RE: Your APS Fuel Electrode Invention Disclosure

George, thanks for your effort. I made all your changes and also incorporated changes you made in the other APS patent application that we filed a few months ago. Sandy will be contacting you shortly for your signature on the formal documents (declaration and oath).
Regards. John

John P. Musone, Esq.
Intellectual Property Counsel
Siemens Corporation
4400 Alafaya Trail
Orlando, FL 32826
(407) 736-6449 (ph)
(407) 736-6440 (fax)
john.musone@siemens.com

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-----Original Message-----

From: Folser George R
Sent: Wednesday, January 29, 2003 12:34 PM
To: Musone John
Subject: RE: You APS Fuel Electrode Invention Disclosure

John,

I sent you an E- mail regarding this disclosure. Sorry about the delay in getting back to you.

-----Original Message-----

From: Musone John
Sent: Wednesday, January 29, 2003 12:31 PM
To: Folser George R
Subject: Out of Office AutoReply: You APS Fuel Electrode Invention Disclosure

I will be out of the office January 29- February 4. During my absence, I will be accessing my vociemail but not my email. I will get back to you as soon as possible. If you need any assistance, please contact Dan Staudt at ext. 6-2415.

Tracking: Recipient
Folser George R
Steunenberg Sandra J

Steunenberg Sandra J SWPCLC

From: Steunenberg Sandra J
Sent: Wednesday, June 04, 2003 2:21 PM
To: 'Srikanth Gopalan'; Ruka Roswell J; Folser George R
Subject: docs for your review and signature

Importance: High



APSFuelElectrode.d
oc



Siemens04298Cross
(1).pdf



Siemens04298Cross
(2).pdf



Siemens04298Cross
(3).pdf



Siemens04298Cross
(4).pdf



Assignment.doc



Declaration &
POA.doc

Hello

Gentlemen,

Sorry to be so long in getting back to you with these documents. I didn't realize until I went to send them initially that some edits had not been made and so I had to figure out what attorney was going to handle this file during John Musone's reactivation to the military.

At long last, attached are the spec and drawings, as well as the Assignment and Declaration & POA. If everything is as it should be please execute the attached Assignment and Declaration & Power of Attorney and fax them back to me for filing with the application package (the originals can be mailed back via intra-company mail or standard US mail). Please be certain to check the spelling of your names, addresses, and citizenship prior to signing. The Assignment must be witnessed by a Notary who will fill in the County if it is not already done.

If you have any questions, please feel free to contact me.

Thank you, in advance, for your assistance.

Sandy

Sandra J. Steunenberg
Intellectual Property Legal Assistant
Siemens Westinghouse Power Corp., Q1-111
4400 Alafaya Trail
Orlando, Florida 32826-2399
Phone 407-736-2472
FAX 407-736-6440

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-----Original Message-----

From: Srikanth Gopalan [mailto:sgopalan@bu.edu]
Sent: Friday, May 23, 2003 12:10 PM
To: Steunenberg Sandra J
Subject: RE: info needed for documents

Steunenberg Sandra J SWPCLC

From: Srikanth Gopalan [sgopalan@bu.edu]
Sent: Thursday, August 14, 2003 10:04 AM
To: Steunenberg Sandra J LC
Subject: RE: docs for your review and signature...round three

I just sent them out yesterday.
-Srikanth

-----Original Message-----

From: Steunenberg Sandra J [mailto:sandra.steunenberg@siemens.com]
Sent: Friday, August 08, 2003 5:56 PM
To: 'sgopalan@bu.edu'
Subject: docs for your review and signature...round three

Srikanth,

I still have not received any documents from you either by fax or mail.
Did you send them?

Sorry if I am being a pest.

Sandy

-----Original Message-----

From: Steunenberg Sandra J
Sent: Tuesday, July 29, 2003 12:32 PM
To: 'Srikanth Gopalan'
Subject: RE: docs for your review and signature...round two

You can fax them to me at 407-736-6440 and then mail me the
hardcopies at

Sandra J. Steunenberg
Intellectual Property Legal Assistant
Siemens Westinghouse Power Corp., Q3-040
4400 Alafaya Trail
Orlando, Florida 32826-2399

Thanks for all your help,

Sandy

-----Original Message-----

From: Srikanth Gopalan [mailto:sgopalan@bu.edu]
Sent: Tuesday, July 29, 2003 12:30 PM
To: Steunenberg Sandra J
Subject: RE: docs for your review and signature...round two

Ok I have the forms signed and notarized. Question: Where do I send
them? -SG

-----Original Message-----

From: Steunenberg Sandra J [mailto:sandra.steunenberg@siemens.com]
Sent: Thursday, July 17, 2003 1:58 PM
To: 'sgopalan@bu.edu'
Subject: FW: docs for your review and signature...round two
Importance: High